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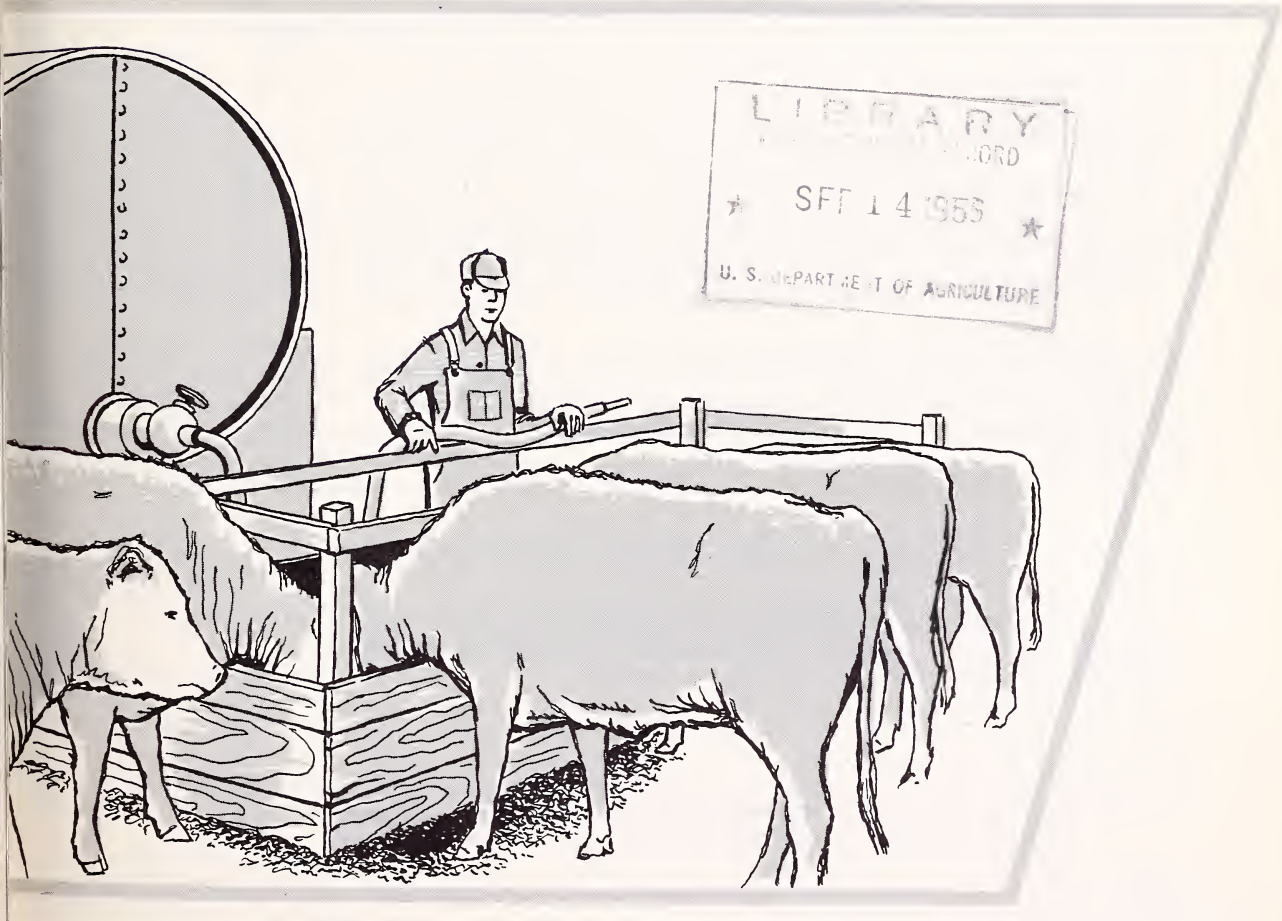
Marketing MOLASSES for LIVESTOCK FEED



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MARKETING RESEARCH REPORT NO. 132

Agricultural Marketing Service Marketing Research Division
UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D.C.
SEPTEMBER 1956

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The study was made under the general direction of C. B. Gilliland, head, Special Crops Section, Marketing Research Division, Agricultural Marketing Service.

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SUMMARY

A recent "spot-check" of farmers, ranchers, dairymen, and feedlot operators indicated that the quantity of molasses used in livestock feeding and the numbers using it are increasing. A total of 181 users were visited in the major livestock-producing areas of the United States, and detailed information was obtained from 117 users who completed the questionnaire. These 117 feeders used more than 1 percent of all molasses distributed for livestock feed in 1954.

Prior to this, no broad study had been made of the experiences of those using molasses for feed relative to costs, returns, advantages, and disadvantages. In addition, actual experience had not been compared with feed test results.

There is ample evidence that molasses can be used advantageously in the rations of livestock. Animal nutritionists have pointed out that molasses can be a very satisfactory feed ingredient. Its primary value is as a source of carbohydrates, but it also has limited quantities of protein and is a good source of minerals, niacin, and pantothenic acid. It is highly palatable, and in combination with dusty or fine-particled feeds, it acts as a binder and dust settler. With coarse roughages for ruminants, it promotes efficient digestion through micro-organism stimulation; in some studies it has been found to yield as good, or better, results as so-called high-quality roughage. Users interviewed in the survey fed liquid and dried molasses direct to livestock, and also mixed it with other feeds. The survey disclosed several handling, storing, and feeding practices which might be helpful to many users. These include adaptation of present equipment and purchases of used equipment, particularly storage tanks, for molasses.

When molasses must be diluted before use, no more should be mixed than will be consumed at one feeding. Mold formation and spoilage can occur quickly in diluted molasses. Other contributions from the experiences of users concerned the emptying of drums of molasses by compressed air, acquainting animals with molasses, and the handling of molasses and its use with various types of high roughage content materials and agricultural waste products.

There are several physical problems involved in handling, storing, and feeding molasses, however, that must be resolved satisfactorily before molasses can occupy its optimum competitive position as a feed. Economies of buying liquid molasses in bulk must be extended to the smaller volume users, particularly those who feed molasses only during the nongrazing months, in order that molasses can compete with other feeds in this market. At optimum feeding rates and present volume of bulk delivery, a tank load (3,000 gallons) would last a herd of 70 cattle 100 days, or about the length of the nongrazing period in many areas. Herds smaller than this would leave a carryover of molasses to the next season. A smaller unit of bulk delivery could reduce the storage investment per animal and also give greater flexibility in purchasing to take advantage of price movements for feed molasses during the feeding season.

Livestock feeders gave a number of reasons for using molasses. In general, these reasons referred to its lower price in relation to the prices of other feeds and to its benefits in the handling of other feeds with which it is combined, in increasing the palatability of other feeds, and in improving the appearance of animals.

Disadvantages given by users concerned the problems of molasses supply, of handling a liquid feed, of the initial costs for feeding equipment, and of the scouring effects on livestock when molasses is fed too heavily.

Even if the problems of handling, storing, and using molasses at the farm can be met satisfactorily, there remains the problem of supplying molasses, at price levels competitive with other feeds, to livestock feeders who have fewer than 100 animals and who are located in inland areas. Cost of transportation continues to be the chief obstacle to pricing molasses competitively throughout the feed market.

MARKETING MOLASSES FOR LIVESTOCK FEED

By
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Agricultural Marketing Service

BACKGROUND

This is a report of findings in a nationwide "spot check" of uses of molasses as a feed for livestock. The purpose of these interviews was to determine and to publicize the experiences of users, so that others could benefit from these experiences.

A total of 181 farmers, dairymen, sheep raisers, and feed-lot operators were visited. This group used more than 1 percent of all the molasses distributed for livestock feed, including mixed feeds. The group's volume of use was between 1/10 and 1/15 of the estimated total of molasses fed in liquid form on farms. Numerous reports have been published by various institutions and sellers of molasses regarding tests, applications, and results achieved with molasses feeding.[1] Prior to this study, no analysis had been made of the experiences of molasses users relative to costs, returns, advantages, and disadvantages of molasses as a feed, to provide an economic evaluation of the results of feeding experiments.

Although it cannot be used to represent the average of all users, the information obtained in the spot check indicates many of the practices and attitudes of livestock feeders that affect the breadth of the market for feed molasses.

MOLASSES AS A FEED FOR LIVESTOCK

Feed molasses is a byproduct of the sugar, citrus-fruit processing, and wet corn milling industries. It is inedible only in the sense that it is not generally used as human food. Animal nutrition and feed utilization studies have shown that molasses is a highly palatable, energy-rich feed. In terms of nutrients, its principal value usually is assumed to be its carbohydrates, but it also supplies limited quantities of protein and is a good source of minerals, niacin, and pantothenic acid (table 1). It is an excellent feed in itself and also it enhances the value and improves digestibility of other feeds fed in combination with it.

The average percentage of carbohydrates in cane blackstrap molasses gives it a feeding value on a weight basis equal to 70 percent of the value of corn. On a volume basis, 6 1/2 gallons of blackstrap molasses equals 1 bushel of No. 3 yellow corn in carbohydrate value. Other types of molasses vary from this relationship slightly, depending upon the total sugar content.

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[1] The majority of livestock feeders visited were using molasses feeding practices and methods described in U. S. Department of Agriculture Leaflet No. 352, "Feeding Molasses to Livestock," October 1953. This leaflet is a brief summary of feeding and animal nutrition tests of molasses feeding. Copies of this publication may be obtained on request from the Office of Information, U. S. Department of Agriculture, Washington 25, D. C.

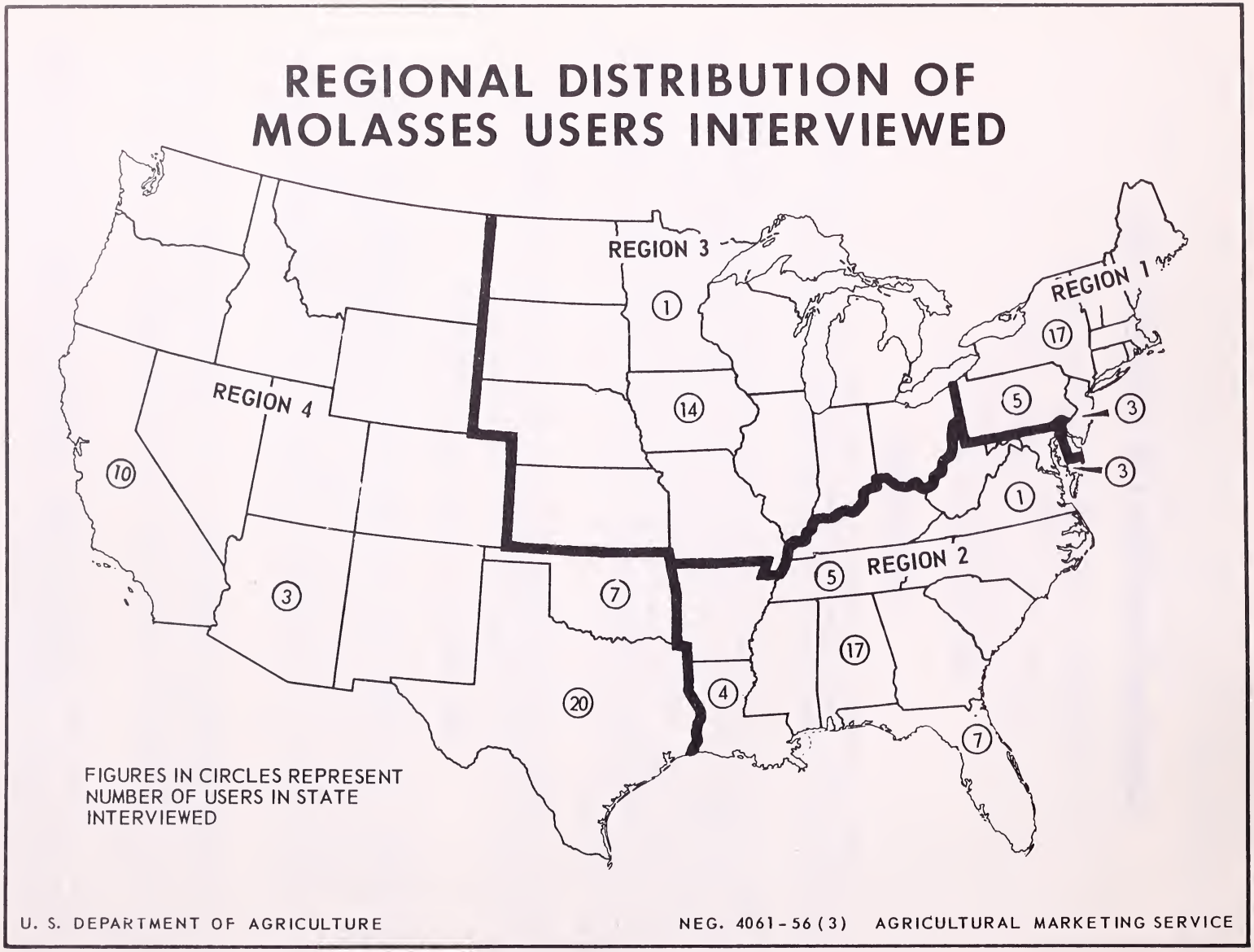

Figure 1. --This map shows the distribution by States of the 117 users who furnished sufficient information for completion of a questionnaire.

TABLE 1.--Nutrients in principal types of molasses

Type of molasses	Percentage of sugars	Percentage of protein	Percentage of solids (Brix[1])
	Percent	*Percent*	*Percent*
Cane blackstrap	48-56	1-3	79-86
Beet	48-52	6-10	80-85
Hydrol	60-64	([2])	75
Citrus	41-43	3-4	70-73

[1] Brix is a measure of density of a sugar solution.
[2] Less than 1 percent.

Maximum levels of molasses in mixed feed rations, as recommended in Leaflet No. 352, "Feeding Molasses to Livestock," are as follows:

Class of livestock	Percent
Beef cattle	20
Dairy cattle	20
Work stock	15
Sheep	10
Swine	20
Poultry	6

In addition to the value of molasses as a carbohydrate, its ability to stimulate digestion of coarse, roughage-type feeds by ruminants has been demonstrated in feeding tests. When fed in moderate amounts, the sugars in molasses stimulate the growth and vigor of rumen micro-organisms. These organisms break down cellulose into more readily digestible sugars and starches. It has been found that molasses in combination with essential ingredients such as proteins, minerals, and vitamins can increase rumen efficiency to a point where low-quality feeds, such as straw, corncobs, and cottonseed hulls, may give as good feed gains as high-quality roughages. This ability of molasses to aid in the digestion of low-quality roughage feeds gives it a value above that derived from its carbohydrates. The saving from utilization of poor roughage instead of more expensive high-quality hay or silage often makes the feed cost per unit of gain lower. Animals like molasses and they will eat feeds flavored with molasses which otherwise would be left uneaten.

The usefulness of molasses to promote microbial activity also is demonstrated in silage preservation. When the silage has insufficient sugars and starches to feed lactic acid-producing organisms in sufficient numbers, the silage will spoil. The addition of small quantities of molasses at the time of ensiling insures sufficient lactic acid for preservation and also improves the aroma and taste of the silage.

Molasses imparts moisture and stickiness to individual feed particles, an important feature when ground feed tends to be dusty or dry. Molasses also has hygroscopic properties (ability to absorb moisture from the surrounding air), and feeds containing it do not dry out so rapidly when exposed to the air or left in the feed trough for a long period. Binding and dust-settling characteristics of molasses are valuable in reducing feed losses from wind and from coughing and choking of animals whenever dusty, fine-particled feeds are used. Also, molasses is used extensively for making pelleted feeds and, in the proper mixture, can be used to produce a pellet without extreme hardness which will withstand considerable moisture and abrasion before breaking apart.

HOW MOLASSES IS USED AS A LIVESTOCK FEED

Feeding Methods and Equipment. --Pouring the molasses on, or mixing it with, grain or roughage was the predominant method of use found, both in number of users and in the

quantity of molasses used (table 2). Free-choice feeding[2] was second in importance. Putting molasses into a mixed feed either by a custom mixing mill or with a feed chopper or mixer on the farm was the third most-used method. Uses for special purposes, such as treatment of cattle affected with ketosis, as a flushing agent for poultry, and other semi-medicinal practices, were not surveyed, although frequent reports of sales of molasses by feed mills and other small-unit molasses handlers were reported for these types of use.

TABLE 2.--Respondents feeding molasses, by region and feeding method[1]

Feeding method	Region 1[2]	Region 2[2]	Region 3[2]	Region 4[2]	Total
	Number	*Number*	*Number*	*Number*	*Number*
Free choice	1	9	5	16	31
On-the-farm feedmixer	2	6	1	10	19
Poured on grain or roughage	16	8	7	10	41
Custom mixing	4	6	1	2	13
Combination of methods	2	8	1	2	13
All methods	25	37	15	40	117

[1] Of the 181 users visited, 117 were able to furnish sufficient information for completion of a questionnaire. The rest of the farms or livestock feeding operations were observed at the time, but owners or other responsible persons were not available to give specific answers required for schedule completion. Observations at these farms where questionnaires were not completed indicated molasses feeding practices similar to farms in the same areas where completed questionnaires were obtained.

[2] See outline map, figure 1, for States included in each region.

Factors found to influence the method of handling and the use of molasses on individual farms and in feed-lot enterprises were: (1) Type of feeding operation, (2) weather, (3) price of molasses, (4) availability of locally grown grains and roughages, (5) flies and insects, and (6) types of mixing and handling equipment for feeds. Individuality and originality of users and their adaptation of available facilities or equipment to use of molasses characterize the situation for most areas. The greatest degree of standardization in use was found among those who mixed molasses with grains to make a complete ration.

Free-choice feeding methods and facilities differed widely. Adaptations by individuals included type and location of troughs and methods of storing and handling. The following were among the major points brought out by the users interviewed.

Feed troughs for liquid molasses should be strong and tightly jointed; they should be sheltered if the area is subject to heavy rainfall, and should be set on a concrete apron, or other firm well-drained footing, to prevent mudholes or collection of filth near the trough. The feeding surface of molasses should be at a convenient height for licking by livestock, but shielded by slatted boards, as floats, to prevent livestock from drinking molasses. Roller-equipped feeders provide the same protection. The frame of feeders should include shielding to prevent animals from getting their feet or underjaw and neck into the molasses.

Molasses may be transferred to feed troughs by gravity flow, pump, or by taking refilled troughs to feeding locations.

[2] Free-choice feeding is permitting access of animals to an unlimited quantity of liquid molasses. The quantity consumed is governed entirely by the appetite of the animal for the molasses in this form.

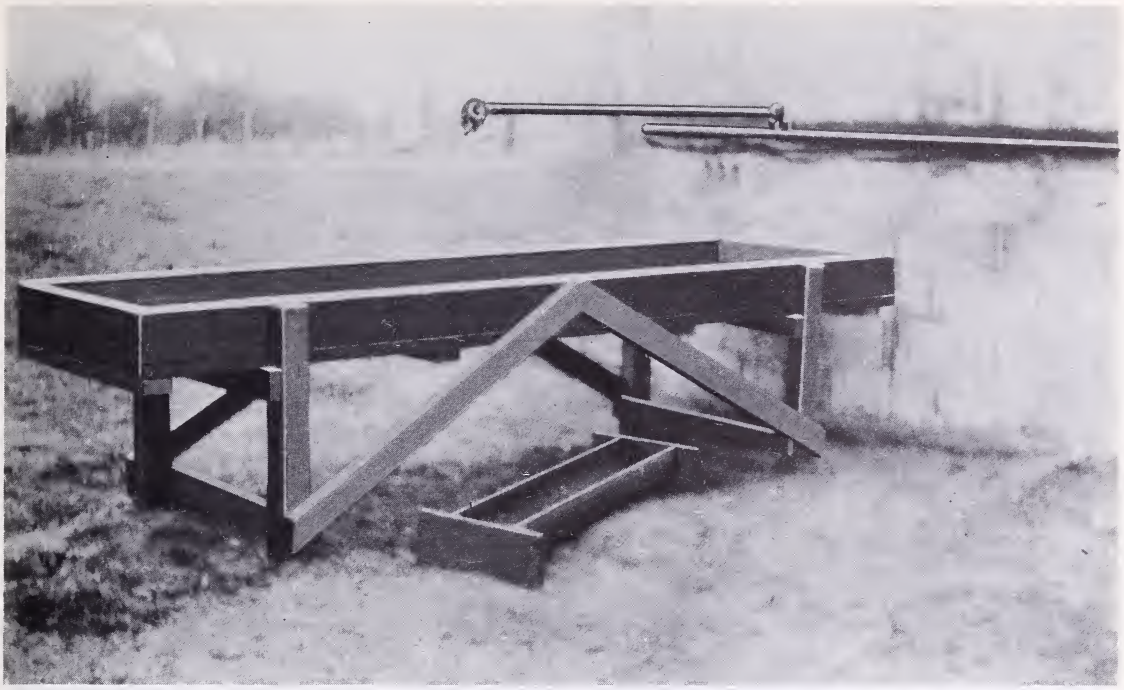

Figure 2. --Homemade molasses-feeding trough supplied directly from storage by overhead pipe.

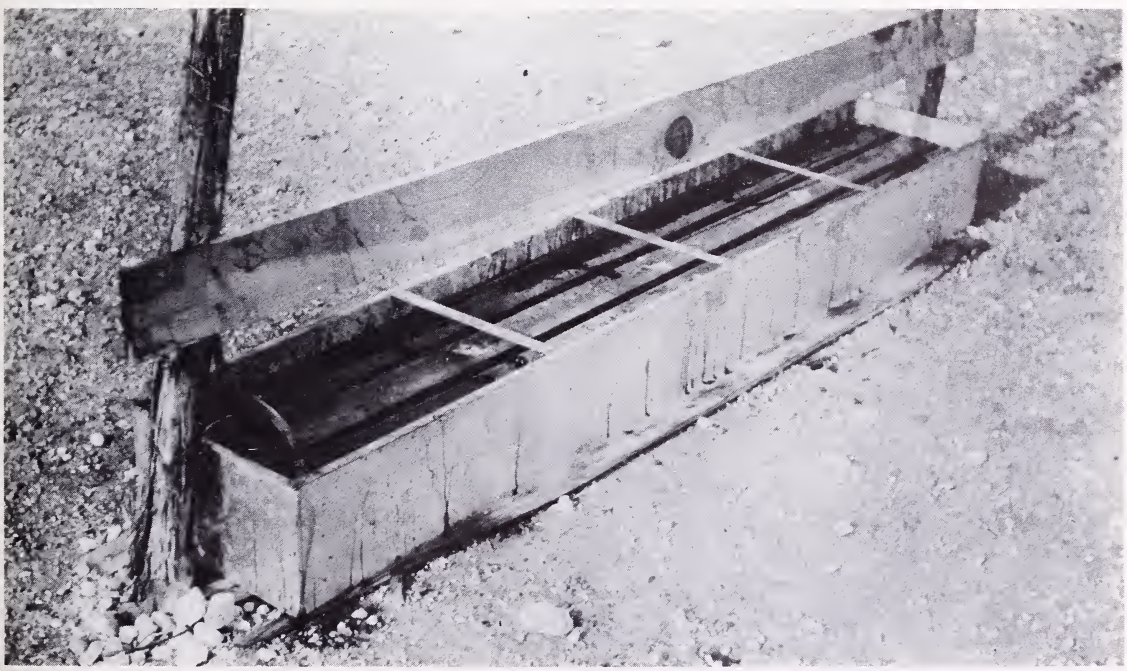

Figure 3. --Commercially made feeding trough (#10-gauge galvanized sheet) with home-built shields and wooden 2" x 4" floats on molasses surface.

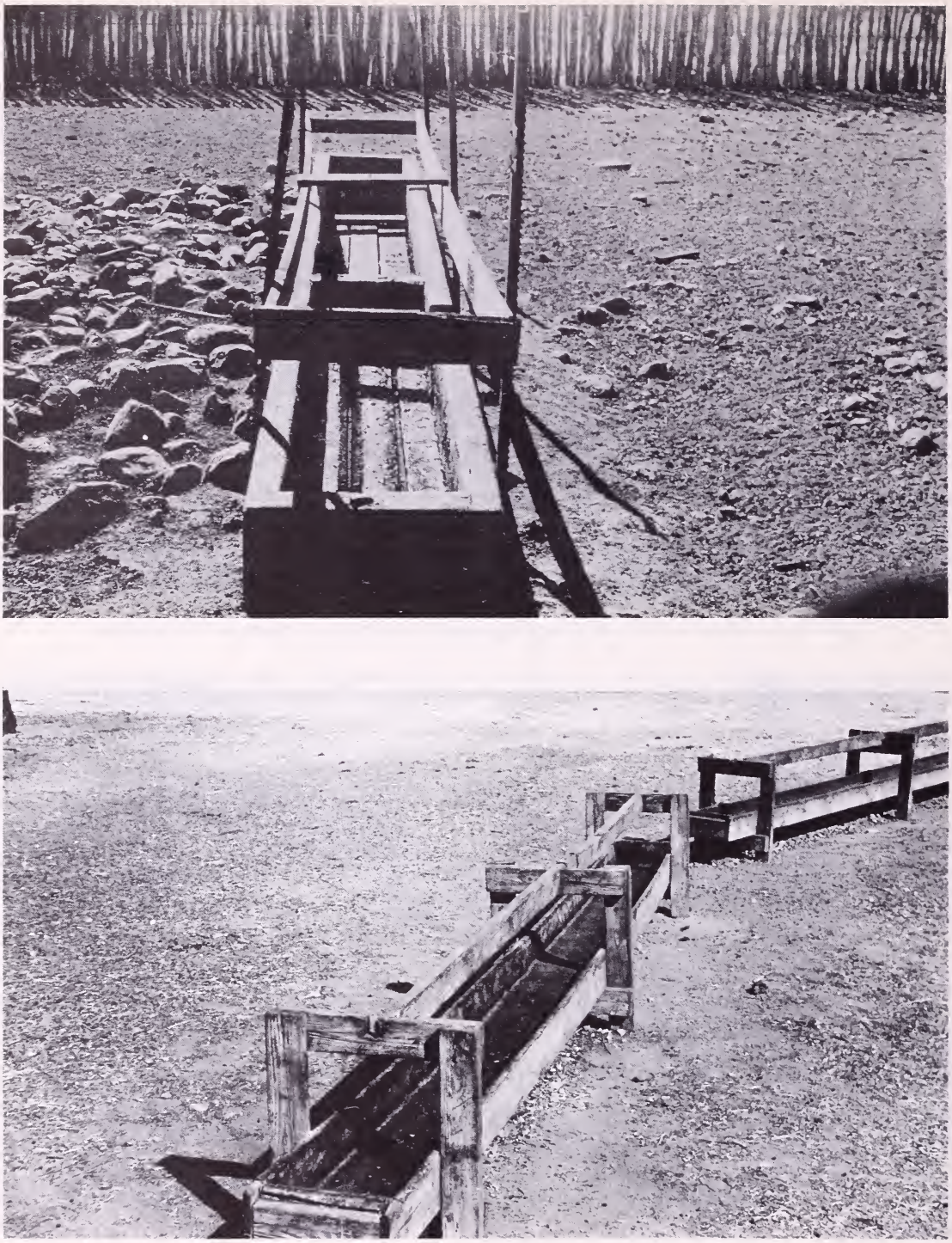

Figure 4. --Homemade shallow metal-lined wood troughs showing two methods of shielding.

TABLE 3.--Respondents feeding molasses, by type of livestock feeding program and method of using molasses

Feeding program	Free choice	Pour on grain or roughage	Custom mix at mill with grain or roughage	On-the-farm feed-mixer	Combination of methods	Total
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Breeding herd...	1	--	--	--	--	1
Dairy.....	7	20	5	4	5	41
Dairy and beef combination...	2	--	--	--	--	2
Beef--range.....	13	13	5	8	5	44
Beef--feeder lot	1	5	1	6	1	14
Beef and hogs combination...	2	2	1	--	1	6
Beef and sheep combination...	--	--	1	--	--	1
Sheep, cattle, goats combination...	4	--	--	--	--	4
Sheep and goats combination...	1	--	--	1	1	3
Poultry.....	--	1	--	--	--	1
Total.....	31	41	13	19	13	117

When a farmer is thinking of using molasses as a feed, he should consider carefully the weight of molasses and of tank trucks or other handling equipment. Molasses weighs approximately 12 pounds to the gallon; a 55-gallon drum of it weighs more than 600 pounds. Tank-truck deliveries, which may be as much as 20 tons of molasses, require an all-weather, preferably hard-surfaced, road adjacent to the unloading point or storage tank.

Weight and viscosity create most of the handling problems in using molasses on the farm. Large sizes of piping, up to 4 inches in diameter, are required for reasonably rapid pumping of molasses at lower temperatures. In very cold climates, heating equipment and below-ground storage or storage in heated buildings are almost a necessity for practical handling.

For emptying tanks, carts, or drums, compressed air in the tank above the molasses can produce a more rapid flow than a pump fed by gravity. Replacing the side bung of a drum with a bung having a pneumatic tire valve welded into it and using an ordinary hand pump can serve very well for this purpose.

Most types of feed-mixing equipment for use with dry ingredients will handle small quantities of molasses, up to about 10 percent of the total mix, without gumming up. If mixed daily, diluted molasses can be used without danger of spoilage, and quantities of molasses greater than 10 percent of the total mix can be used. Mixers designed for molasses can handle more than 10 percent molasses in the mix without trouble, but they add substantially to the investment in molasses-feeding operations.

Equipment for diluting, sprinkling, or spraying was mostly constructed on the farm or was adapted from other equipment. On most farms, the molasses was diluted and sprinkled or sprayed by hand. Some large-volume users had tanks and spraying equipment mounted on dry-feed dispensers from which molasses was sprayed onto the feed as

it poured into feeding troughs. Others had powered equipment for spraying onto silage or onto dry pasture grasses.

Whenever diluted molasses is used, no more should be made up than can be utilized at a single feeding. Spoilage and formation of possibly toxic substances occur quickly when the density of molasses is reduced by dilution. This fact makes the dilution and sprinkling of molasses the most expensive method of use in labor and handling costs. From the standpoint of feeding advantages, however, when cheap roughage is available, it is one of the more advantageous ways to feed molasses.

Costs of Molasses-Feeding Equipment. --Equipment used for handling and dispensing molasses mixed with, or poured on, feeds varied in size and cost from a 1-gallon sprinkling can to complex and costly feed mixers and molasses blenders ranging in cost from about $750 up to several thousand dollars, depending on the capacity. Many feed lots had belt or screw conveyors or bulk-feed dispensing trucks to transport mixed feeds to the troughs.

Many feeders who used the free-choice way of feeding liquid molasses built their own feeding troughs either of wood or by cutting steel drums lengthwise and anchoring the half sections to form troughs. Commercially built metal troughs approximately 8 feet long, 1 foot wide, and 8 inches deep, were found to cost $30 each in one area. A unit of this size was used for about 75 head of pastured cattle. A similar unit was used in a feed lot to feed about 25 head. In comparison to the troughs, inverted drum feeders similar to poultry waterers are more expensive, costing from $30 to $90 each, depending on the capacity, but more satisfactory for use in feed pens. The inverted drum feeders are less likely to be tipped over than the smaller narrow troughs, and, as they do not require anchoring to the ground, cleaning the pen is easier.

Figure 5. --Poultry waterer type drum feeder used in a dairy herd exercise lot.

Other equipment for farm use of liquid molasses included such items as self-feeders of 200- to 300-gallon capacity mounted on skids for movement by tractor to storage tanks for refilling. Equipment of this type at one farm included a used liquefied petroleum gas (better known as "LP" gas) tank, automatic float valves, and 12-inch pipe cut lengthwise to form troughs, all mounted on a steel frame and skids. This equipment cost the user an estimated $300 per unit. A commercially built unit of similar capacity cost another user almost $500.

Storage Facilities for Liquid Molasses on the Farm. --The storage facilities and equipment used for molasses were varied. Type of feeding operation, delivery methods and practices of the supplier, and volume of molasses used, largely determined the storage facilities and equipment used.

Storage facilities may vary from a single drum to a large tank holding several thousand gallons. The important features of storage facilities are dependent upon the requirements of the user and delivery practices of the supplier, including the advantage to the user of a price of as much as 10 cents a gallon lower as a result of his being able to receive tank truck or carlot deliveries.

Annual rate of use compared with storage capacity differed greatly between the group of users having drums for storage and the group of users having bulk storage. Users with drum storage facilities utilized 149,951 gallons of molasses in 1953. Their storage capacity was 20,025 gallons, and their annual turnover rate was equal to 7.4 times the storage capacity. Users with tank or cistern storage utilized 5,606,577 gallons and had a combined storage capacity of 360,560 gallons. Their turnover rate was equal to 15.5 times their storage capacity and slightly more than double the rate of drum storage users.

Individual users in each group differ widely from the average. Some with 2 or 3 drums for storage had these refilled as often as twice monthly if they were on a regular delivery route of a tank truck operator. Others in the bulk storage group had only 1 delivery per feeding season. One user had required only 1 delivery by tank truck for 2 seasons.

For a user who desires to sprinkle molasses on roughage for a small herd (up to 10 head), a single drum set on a stand for easy drawing of molasses may be all that is required. The drum should be sheltered from the hot sun and from extreme cold to prevent extreme expansion and to make it easier to draw out molasses in cold weather.

A battery of several drums makes receipt of a bulk quantity possible and eliminates the heavy job of moving filled drums. A winter season's supply for a small herd can be received in a single delivery when drums are used in this manner. The cost of receiving such a bulk lot is substantially below, in some areas even less than one-half, the delivered cost per gallon of molasses in single-drum lots.

If a larger supply is required, a tank with pump or gravity flow outlets can be installed. The tank can be of wood, concrete, or steel. Some savings in installation costs were made by some users who acquired used gasoline or oil storage tanks. These tanks were cleaned of rust and residues before purchase.[3] The price of these tanks was generally at or slightly above the junking value of the metal and about one-fourth the cost of new steel tanks. The average cost of new steel tanks in the Southern and Southwestern areas was 7 cents per gallon of capacity. Tanks of all types averaged $63 per 1,000 gallons of storage capacity and ranged from $10 for discarded gasoline tanks (these tanks ranged in cost from $10 to $40) up to $100 for completely installed units. Some used

3 Thorough cleaning of used tanks before use for molasses storage is very important. Many residues of petroleum are toxic to animals and may poison the animals that eat molasses from improperly cleaned tanks.

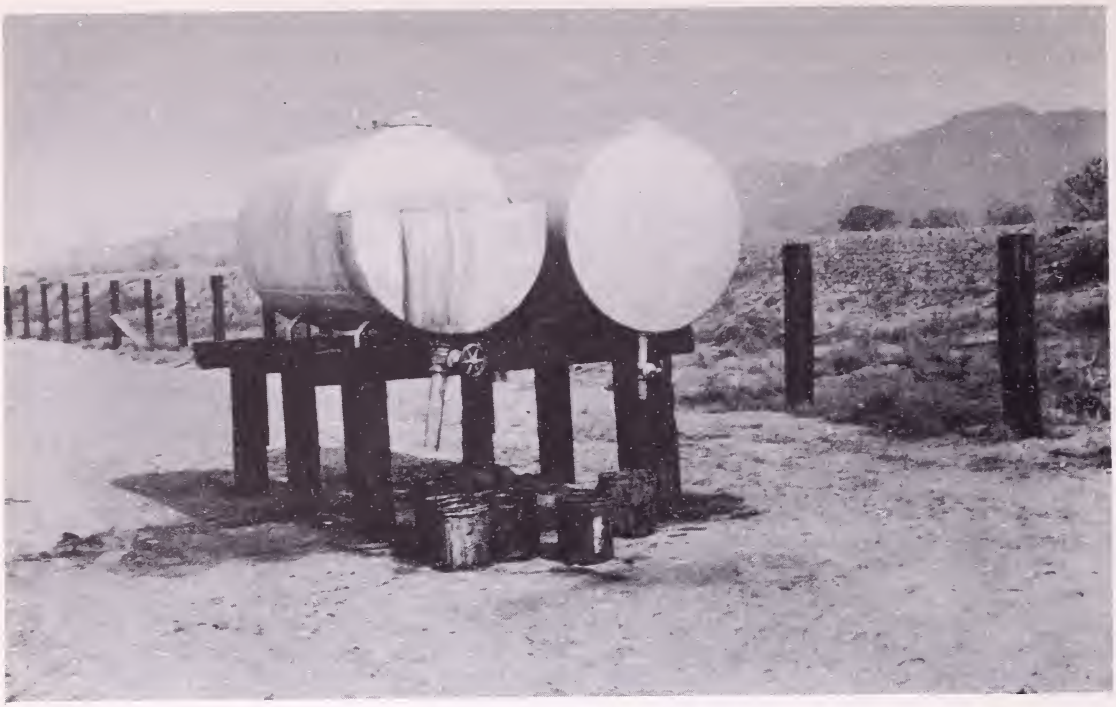

Figure 6. --Used steel tanks reconditioned for molasses storage.

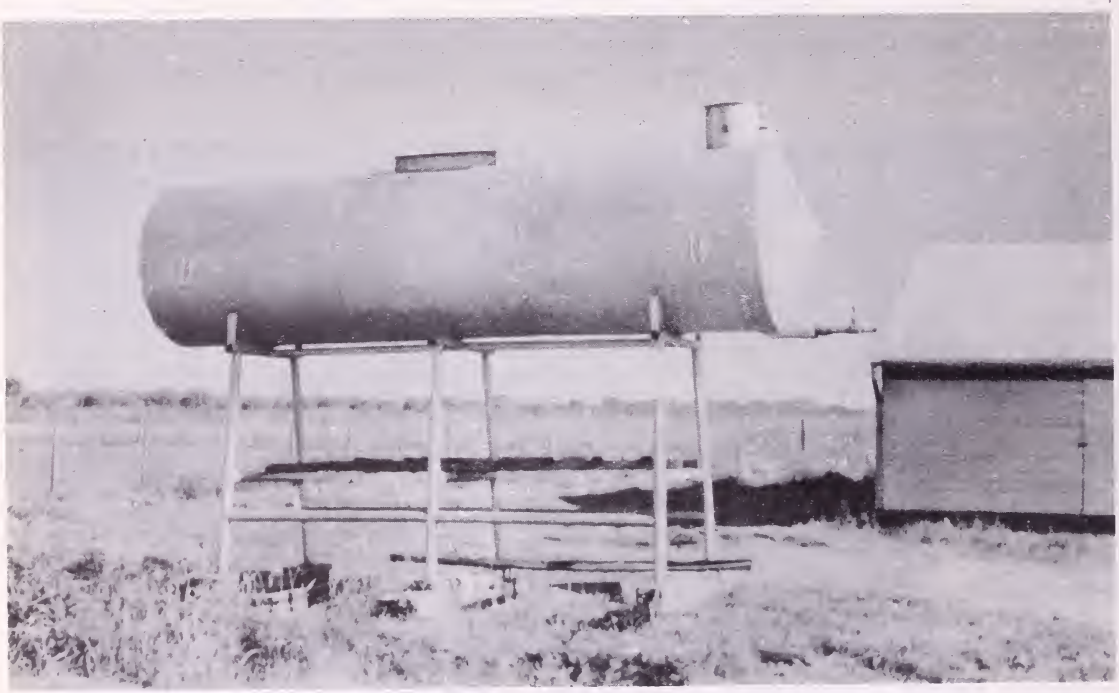

Figure 7. --Custom-made steel tank for molasses storage.

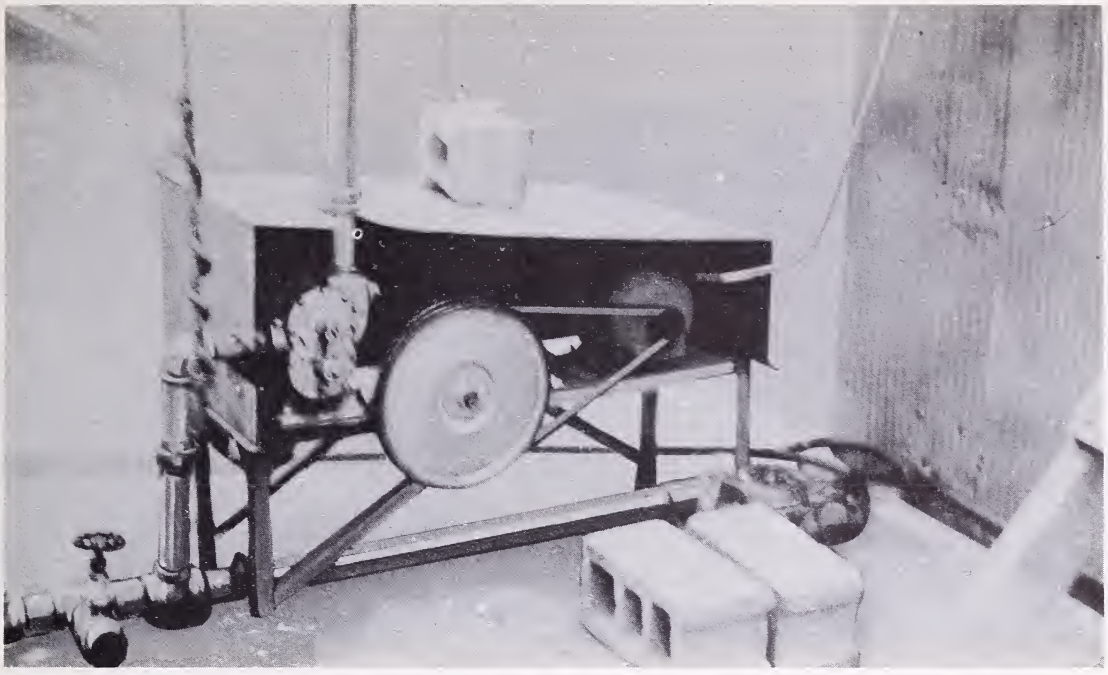

Figure 8. --Electric motor-driven centrifugal pump for molasses handling between storage tanks and portable tanks.

Figure 9. --Small, used water tank for molasses storage. Receipt of part loads from a tank truck is necessary to use such a small unit of storage.

Figure 10. --Molasses tank cart (homemade, using old tractor wheels, used tank, and home-welded steel frame).

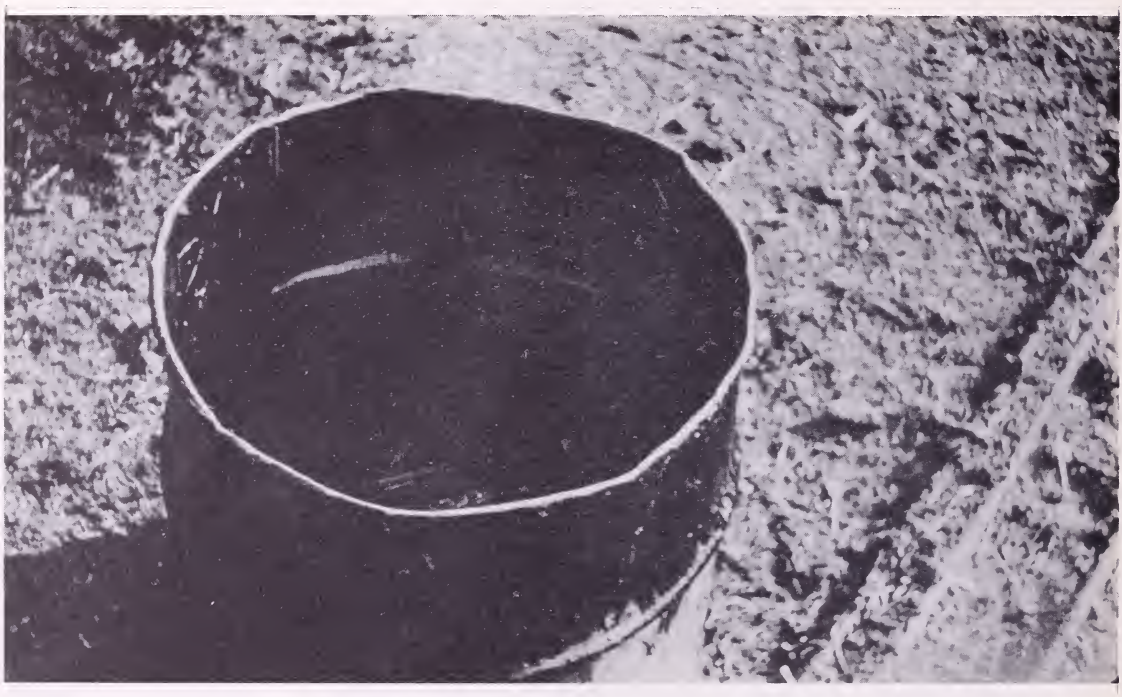

Figure 11. --Molasses feeder tub for emergency use made from half of a 55-gallon steel drum.

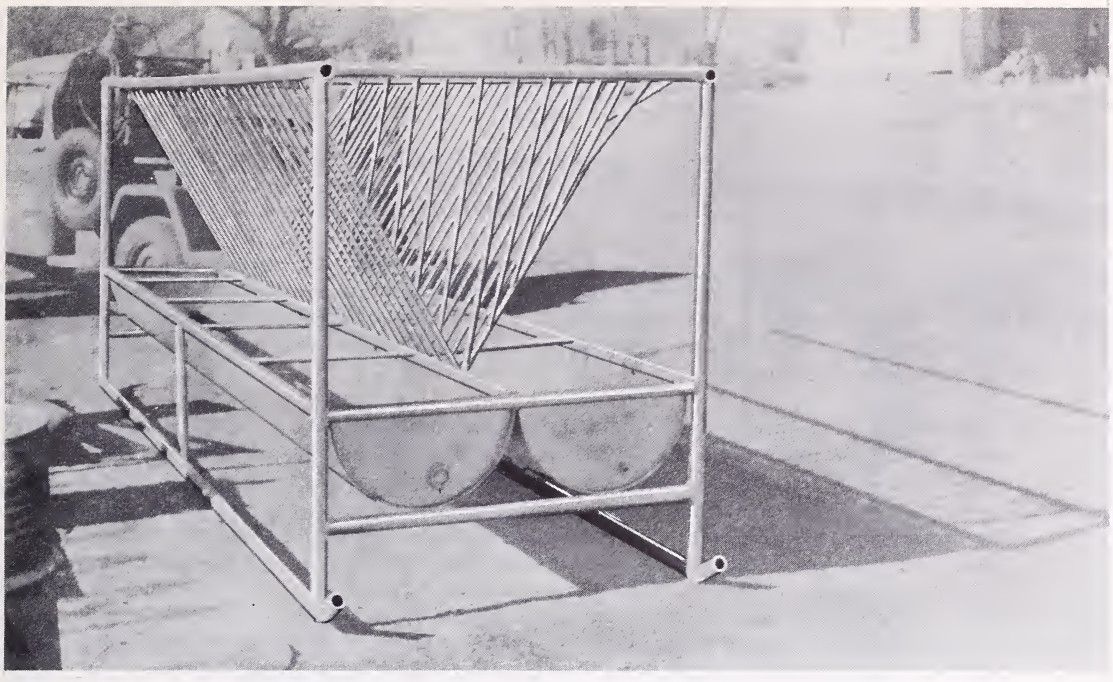

Figure 12. --Custom-built molasses, grain, and hay feeder. Molasses is sprayed onto the hay-filled rack and onto mixed feed in the troughs.

Figure 13. --Concrete feeding trough for truck-mounted dispensers for molasses-with-grain mixtures at a large feeder lot.

tanks were more costly than new ones of the same capacity; however, no measure of the relative merits of the tanks was possible. Costs of concrete cisterns and wooden tanks were not obtained in a sufficient number of instances to quote. Concrete tanks were most widely used where volumes exceeding 3,000 gallons were delivered.

Many of the feed mills operated in conjunction with feed lots and large dairies had concrete molasses cisterns in the foundations of the feed-mill houses. Capacities of these cisterns were generally sufficient to receive one or more rail tank-car loads.

Rates of use of Molasses for Feed. --The reported rate of feeding molasses varied considerably between areas and between feeding methods. In mixed feeds and in ground or chopped feeds and roughages with molasses poured over them, the rate of use varied from 5 to 15 percent of total rations fed, with a few users reporting up to 50 percent molasses in roughage-type feeds.

Most of the users who fed molasses by free-choice methods said that the quantity of molasses eaten by cattle averaged about 3 1/2 to 4 pounds per head per day. A few users in one area reported that the rate of eating pure blackstrap was too high. These users said that they cut the rate of intake by using various additives, such as urea or salt, or by blending the pure blackstrap with corn molasses to reduce the palatability of the molasses. In most free-choice feeding operations, however, no problem of excesses in consumption were reported after the first few days of feeding. Many users were emphatic in stating that restriction of daily intake was necessary for animals when they were first fed molasses. The animals were restricted by giving them only a measured quantity daily or by allowing them access to the feeders for a short time after each dry-ration feeding or after each milking. Several operators reported that giving the animals a full feeding before allowing them access to the free-choice molasses feeders prevented them from overeating molasses at the beginning.

WHY MOLASSES IS USED AS A LIVESTOCK FEED

Cost of Molasses Relative to Its Feed Value. --In all but 2 of the last 14 years wholesale molasses prices at port terminals have been below the feed-value equivalent in terms of corn at these same points. Figure 14 shows the price differential in cents between the cost of 6 1/2 gallons of molasses and a bushel of No. 3 yellow corn based on the New York City wholesale market quotations. (See also table 4.)

Price differentials for different interior livestock feeding and feed milling points are narrower than those shown in figure 14 for New York City because the relative costs for freight on molasses and corn are changed.

Transportation Cost of Liquid Molasses Going to Farm Use. --The range in prices paid by farm users for molasses was wide; the price depended primarily upon (1) distance from the port terminal or other source point, (2) the method of delivery, and (3) the unit volume of delivery.

Tank truck operators charge for delivery according to the round trip distance if no other delivery rate schedule is available. Charges of independent tank truck operators for typical loads of 3,000 gallons (17.5 tons) ranged from 24 to 35 cents per mile. At the median level of 30 cents, this equals 1/10 of a mill per gallon per mile. A freight charge representing this rate for a customer 50 miles from the terminal would be 3,000 x 0.01¢, or $30. In some areas at a distance from the terminal city, an average freight charge is set for the entire area. This average freight charge helps handlers and buyer-seller relations by eliminating slightly different charges to users in the same general area. In the Montgomery, Ala., area, the charge for trucking, as reported by several users, was 5 cents per gallon. The nearest port terminal, Mobile, is 200 miles away. In this case, the round trip charge was equal to 0.125 mills per gallon per mile.

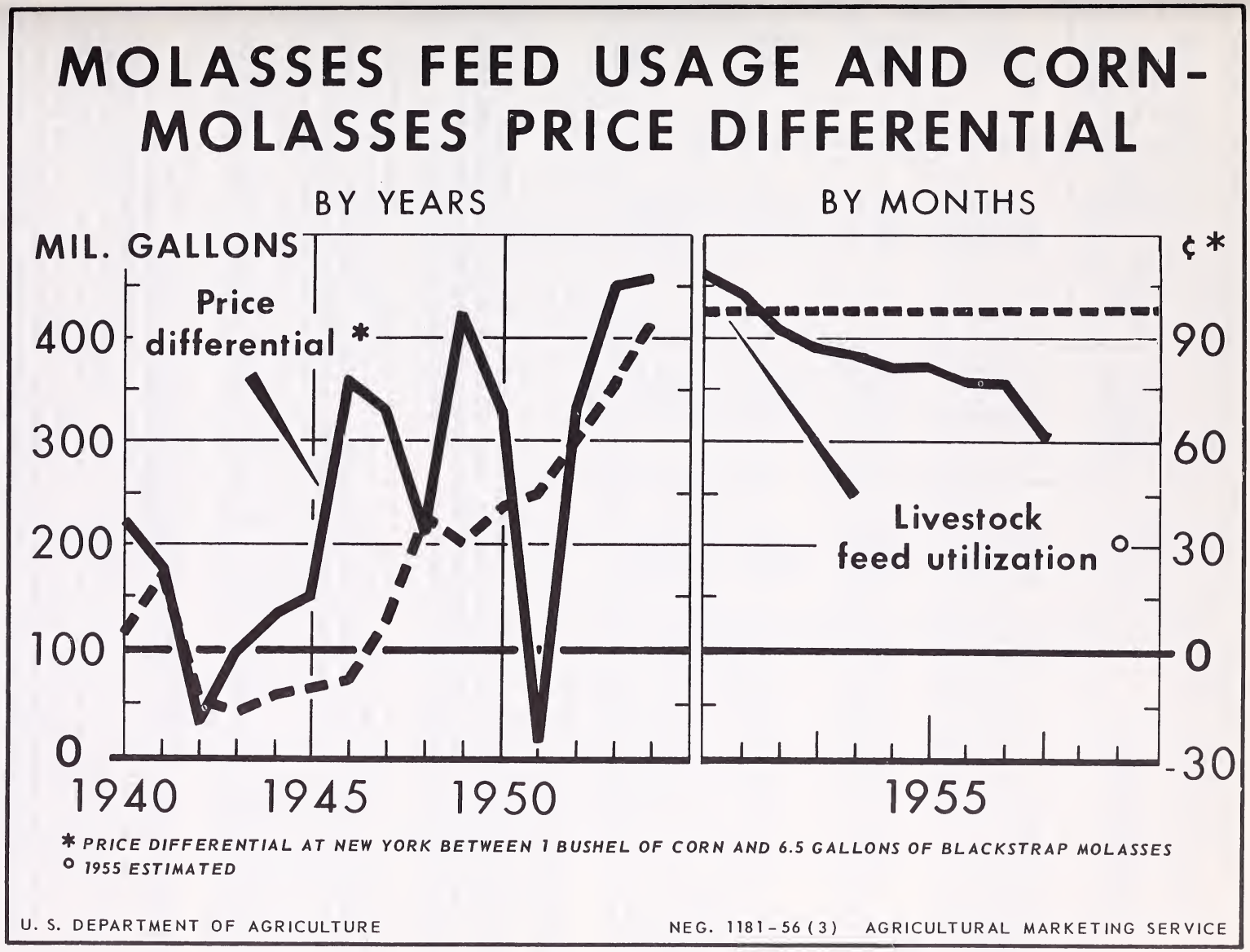
MOLASSES FEED USAGE AND CORN-MOLASSES PRICE DIFFERENTIAL
BY YEARS
BY MONTHS
MIL. GALLONS
¢ *
Price differential *
Livestock feed utilization °
400
300
200
100
0
90
60
30
0
-30
1940
1945
1950
1955
* PRICE DIFFERENTIAL AT NEW YORK BETWEEN 1 BUSHEL OF CORN AND 6.5 GALLONS OF BLACKSTRAP MOLASSES
° 1955 ESTIMATED
U. S. DEPARTMENT OF AGRICULTURE
NEG. 1181-56 (3) AGRICULTURAL MARKETING SERVICE

Figure 14.

Table 4.--Average wholesale prices for corn and for cane blackstrap molasses at 4 major feed-mixing centers, by months, October-December 1954

Feed-mixing center	Price per bushel of corn[1]	Price per gallon of molasses	Price of molasses equivalent of 1 bushel of corn	Corn price above molasses-equivalent price
Minneapolis-St. Paul:	*Cents.*	*Cents.*	*Cents.*	*Cents.*
October	143.4	20.64	134.16	9.24
November	139.7	20.51	133.31	6.39
December	138.3	20.19	131.23	7.07
Chicago:				
October	158.0	15.10	98.15	59.85
November	149.0	15.00	97.50	51.50
December	153.0	14.86	96.59	56.41
St. Louis:				
October	159.0	14.60	94.90	64.10
November	157.0	14.45	93.93	63.07
December	160.0	14.10	91.65	68.35
Kansas City:				
October	161.0	17.85	116.02	44.98
November	154.0	17.68	114.92	39.08
December	153.0	17.42	113.23	39.77

[1] No. 3 yellow corn at Minneapolis, St. Paul, Chicago, and Kansas City; No. 2 yellow corn at St. Louis.

Method of bulk delivery, whether by tank truck, rail tank car, or by partial load of a tank truck, affected costs of molasses to the user. The charges for rail and tank truck delivery are equal in many areas adjacent to the supply point, but in areas beyond 250 miles from the port terminal, the rail car receiver usually has an advantage.

Most tank truck operators will charge extra for delivering partial loads, depending upon the division of the load. Some users paid as much as 10 cents a gallon above delivery charges in tank truck lots when they received only 200 or 300 gallons per delivery. Service charges for filling drums at terminals and prices per gallon for molasses in drum lots made this method of receiving molasses more expensive than bulk deliveries. Service charges for filling drums ranged from 0 to 10 cents per gallon above bulk delivery charges. Prices of molasses sold in drum lots by feed mills and other suppliers were frequently prohibitive except for special uses, such as for silage preservative or for "medicinal" feed purposes.

Influence on Use of Other Feeds as Reported by Molasses Users.--Experiences cited by users agree substantially with the results obtained in feeding trials reported earlier in this report. The largest group, the feed-lot operators, dairymen, and others, who regularly purchased all or nearly all feeds used, regarded molasses as an economical source of carbohydrate and fed it as such, replacing a portion of other carbohydrates with the molasses. This group of users did not consider molasses solely for its carbohydrate value; they were also interested in its palatability, which encouraged maximum consumption of the feeds mixed with it and aided in digestion of these feeds.

Users located in areas affected by drought and reduced forage looked upon molasses as the least expensive method of feeding their livestock in the emergency period. Emphasis was placed on its use to make poor-quality roughage more palatable and as a

substitute for grains or mixed feeds the users would otherwise have to buy. Price of molasses in comparison with other materials of like feeding value was the principal reason given for feeding molasses. No users indicated that they had voluntarily reduced production of homegrown feeds on account of feeding molasses. Many of those who had begun its use during the drought indicated they would continue buying some molasses, mostly as a substitute for other carbohydrate feeds, even when local feed growing conditions improved. Molasses would be used for feed as long as the price was favorable in relation to comparable feeds.

In areas where some high roughage-type[4] agricultural byproduct was plentiful and relatively cheap, such as corncobs in the Corn Belt, cotton gin waste and cotton stalks in the Cotton Belt, or hay from threshing soybeans, the users of molasses took advantage of these low-cost feed materials. They reported that molasses made these feeds more digestible and that feeding costs per pound of gain were lower than for grains or other higher cost feeds.[5]

Some users who combined these roughage materials with urea-supplemented molasses or with a high-protein supplemental concentrate reported gains in weight at a cost for feed of as much as one-third lower per pound than the cost for the regular grain, hay, and protein concentrate fed formerly.

Special-occasion use or "giving molasses a trial" was the fourth reason given for using molasses with other feeds. A surplus of straw or other poor-quality roughage, which the farmer wanted the livestock to eat, or a few extra head of stock, which he desired to carry through to grazing season, were examples of special occasions. In these cases, the user bought molasses in small quantities. Diluting the molasses and sprinkling it on the feed at each feeding time was the usual practice. When the special need was past, the farmer would not buy molasses again until another similar situation occurred. Many small-volume users began feeding molasses in this way and then shifted to direct use of liquid molasses as a free-choice feed or mixed it with their dry feeds.

A use of molasses practices by open-range cattle feeders in the Southwest is worthy of special note. Feeding was changed from daily to every other day with lower labor costs resulting. Baled hay and molasses were hauled to range feeding points. A gallon of undiluted molasses was poured on the hay and allowed to soak into each of the bales. Cattle chewed on the unopened bales and by the second day the twine loosened, but the molasses-moistened hay would stay in place until eaten. Less waste of feed from scattering by the wind and from trampling was the result. Labor costs for open-range feeding were also lowered.

One question asked several times during the survey concerned the effect of molasses sales for feed purposes on the market for other feeds or feed grains, particularly the market for corn.

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[4] High-roughage materials are those in which the major portion of carbohydrate is cellulose (fibrous material of low feeding value unless digestion is stimulated by high organic activity in a ruminant's stomach).

[5] A typical mixed high-roughage feed formula used included the following ingredient proportions:

1,000 lbs. of ground corncobs, gin waste, or other roughage material.
100 lbs. of cottonseed meal, soybean meal, or other protein concentrates.
160 lbs. of molasses.

Plus minerals and salt.

This was poured in feed troughs in its semidry form and additional quantities of molasses up to 25 percent of mixture were diluted and poured on top to give a 40- to 50-percent molasses feed. Gains up to 1 1/2 lbs. per day were reported for feeder cattle on this ration.

The total available supply of molasses for feed is considerably less than 1 percent of the supply of all feed grains when considered in terms of its feed value (48-56 percent carbohydrates). Distribution of molasses for feed use in 1954 equaled 2.36 percent of the corn supply for feed use. If all the available supply of molasses in 1954 had been fed to livestock, its feed-value equivalent would have equaled only 3.39 percent of the corn utilized for feed.

Statements of users indicate that molasses is used not only for grain replacement purposes, but also for palatability and as a binder and dust settler. For the latter, molasses stands on its own merits as an ingredient of the ration, rather than as a substitute for any grain which otherwise might be included in the feed.

Feed Values of Molasses Reported by Users. --Three major feed values of molasses were reported by the users interviewed. The largest volume of molasses was used by those who substituted it for grain in varying percentages of carbohydrate requirements in the total feed ration. Improvement in consumption of less-palatable feeds and roughages was the second major feeding value given. Use as a binder, dust settler, and moistener of dry feeds was the third major value suggested by users.

Users also emphasized the value of molasses to them as an "appetizer" and "conditioner." Many users who recently began feeding molasses indicated that it seemed to stimulate the appetites of animals and that the animals drank more water. This was reported to be true both for free-choice feeding of liquid molasses and for molasses poured on roughages or grain. Those who put the molasses on roughage or grain were enthusiastic about the way animals cleaned up the feed put before them with less waste and less refusal to eat.

Some dairy operators reported an increase in the quantity of milk produced when molasses was added to the ration. Other dairy operators with longer experience with molasses did not feel that molasses had any appreciable effect on milk production if a balanced ration already was being fed. Its value as a binder and dust settler and to improve palatability of feed was most important to them. Special problems with free-choice feeding of liquid molasses to milk cows are discussed on page 19.

In the areas severely affected by drought during 1951, 1952, and 1953, molasses has been fed extensively as an emergency measure. In the Edwards Plateau area of Texas, sheep ranchers reported that the use of molasses was largely brought about by the need for a feed to supplement the severely damaged grazing lands.[6]

Many users reported aid to digestion of poorer quality feeds to be the principal value of molasses. A nutrition study at Iowa State College of Agriculture[7] indicates that ground corncobs when supplemented with nutrients required by micro-organisms, including molasses, proteins, phosphorus, trace minerals, and vitamin A, may become as valuable, and sometimes more valuable, as a feed for cattle as some of the so-called high-quality roughages.

Results from this study and from similar tests and feeding trials are borne out in the practical experience of users. Those reporting its value as an aid to digestion were applying molasses directly to the feed, either by a mixer or chopper, or pouring it

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[6] One rancher reported he was either going to have to sell his sheep or ship them to eastern Texas to be put on grazing land. At the time of his emergency, hay and grain were too expensive when compared with returns from sheep raising. On a trip to lease grazing land, he learned of molasses feeding for sheep. After he had installed liquid-molasses feeders, he reported that the condition of his flocks was as good as when pasture was available if not better. Molasses feeding cost him less than rented grazing lands and much less than the hay and grain he would otherwise have had to purchase.

[7] "High Roughage Materials," address by Dr. Wise Burrough, Iowa State College, at 44th Annual Convention of Association of American Feed Control Officials, Washington, D. C., October 14, 1954.

directly onto the feed at feeding stations. Roughages used in this way included finely chopped grain straw, hay, grass silage, cotton gin waste and cottonseed hulls, cotton stalks, corn fodder and husks, bean fodder, and palmetto foliage.

Those users who referred to palatability as the major value of molasses were, in the main, those who wanted to get rapid weight gains or increased feed consumption. Feed waste and failure of animals to clean up all the feed put before them are problems which the palatability effects of molasses on other feeds have helped to solve.

PROBLEMS IN USING MOLASSES

Physical Characteristics Affect Its Use. --Molasses is a sweet, sticky, viscous fluid that is more perishable than many feeds handled by the livestock raiser. Most users emphasized the need for proper handling which would eliminate spilling and for sturdy dispensers placed on firm foundations as a necessary sanitary precaution.

Molasses has a high coefficient of expansion, and adequate head space is necessary to allow for expansion on warm days (a 55-gallon drum should be filled with no more than 50 gallons). It also has a tendency to foam and to trap air bubbles for a long period when it is poured or pumped from one container to another, so that weight rather than volume is the better measure of the total quantity.

Flies and other insects are attracted to it in warm seasons and will get into troughs or on sprinkled feeds in great numbers. They also are attracted to animals that have molasses on their hair coat. Some users discontinued using molasses except in ground or mixed feeds during the fly season on account of this problem.

Second to the problem with flies, users mentioned the laxative effect of molasses. Scouring was checked by reducing the quantity of molasses in the ration or eliminating it completely for a few days until the condition cleared up. Free-choice feeders were the only ones reporting this problem. Feeders who mix molasses with ground feeds or pour it on roughage have better control of the quantities consumed and also, as one user put it, the other feed "gives them enough fiber and solids so that the molasses doesn't affect them."

Molasses is heavy and can make a messy feeding job when it is handled, diluted, and mixed by hand. The segment of the user group interviewed who were using hand methods indicated its weight and viscosity to be the major problems in using it.

Sheep raisers reported two problems with molasses. Getting molasses into the wool was the problem mentioned most frequently. Molasses feeding was stopped 3 to 4 weeks before shearing to avoid sticky, molasses-colored wool at shearing time. A couple of ranchers reported that ewes refused to claim their lambs after the lambs had gotten into the molasses trough. No ready solution had been found for this complaint.

Caking of mixed feeds containing molasses was reported by one user who mixed his own molasses-containing feeds and stored them for several weeks before use. This problem was eliminated by remixing the feed just before use.

Molasses has a tendency to leach out of silage, resulting in high losses of molasses. These losses were reduced or eliminated by using less molasses on high-moisture silage and by putting additional molasses on silage at feeding time instead of putting all of it into the silo. Gumming up the ensilage cutter was reduced by diluting the molasses or by switching to a dried molasses concentrate.

Effects of Molasses on Animals. --Molasses, especially cane blackstrap, is usually readily accepted by animals; beet molasses is somewhat less appealing. Citrus and corn molasses (hydrol) require a short period of time for animals to reach the desired daily intake levels (3 to 5 pounds per day per 1,000 pounds of body weight).

A few dairy operators reported that free-choice feeding of milk cows lowered milk quality and reduced consumption of hay and protein concentrates because some cows have a "sweet tooth." Use of limited quantities of molasses mixed with or sprinkled on hay and feed concentrates was being tried as a cure with apparent success by one operator.

This variance in "sweet tooth" characteristic can be a problem when molasses is fed free-choice to the entire herd. Some animals will lick at the molasses much longer than others. A few rare and extreme cases were reported in which an animal would live on molasses and water, with a loss of weight and the development of a poor appearance. In these instances, the operator was forced to stop molasses feeding by keeping the animal from free-choice feeding stations.

The influence of molasses upon market grades of products from animals could not be fully determined from the interviews of molasses users. Wool with improved gloss and curl was reported by several of the sheep raisers. The grade for wool was also reported to be better from sheep fed with molasses in the ration. Feed-lot gains of lambs were reported to be improved when molasses was added to the mixed feed ration. They graded better and their condition and appearance were bet[illegible]

Beef raisers were divided in their opinions of the effects of molasses on the quality and grade of beef from animals fed molasses:

(1) Among more recent users of molasses, an opinion was held that molasses made the beef more pink and the fat looser and off-white in color. They recommended that molasses be removed from the ration several weeks before slaughter.

(2) Among users who had fed molasses for 10 to 25 years, the opinion was that molasses fed at the level of 10 to 12 percent of total ration was beneficial to meat quality and grade. This was the opinion particularly of feed lot operators in the Southwestern and West Coast States. These users said that molasses stimulated digestion and high volume intake of feeds with rapid conditioning for slaughter. In several instances, sugar was used in addition to the molasses ration in the last few days before shipment for slaughter. This additional sugar prevented animals from going off feed and losing weight during shipment when molasses was not included in the ration. Up to 3 pounds of sugar per head per day was used for this purpose. In carbohydrate equivalents, this amount of sugar is equal to 6 to 7 pounds of cane blackstrap in the daily ration.

Among some users, molasses is believed to have valuable medicinal properties in addition to its feed value. That milk fever and ketosis among cattle is reduced in frequency was an often-heard comment. It should be noted that molasses is regarded as a preventive and not as a cure for these conditions. Stockmen or veterinarians used glucose and other medication to treat animals that had these diseases, but users reported that the occurrence of the disease was reduced or eliminated when molasses was included in the ration.

Some of the sheep raisers attribute medicinal value to molasses as a preventive of abortion among ewes. One user reported a striking reduction in frequency of abortions after he began using molasses as a free-choice feed for his flock.

THE PRESENT MARKET FOR MOLASSES AS A FEED AND TRENDS INDICATED

Trends in Use of Liquid Molasses by Livestock Feeders. --Purchases of liquid molasses by livestock feeders show an upward trend from 1951 through 1953. The number of purchases increased, particularly in the Northeast and the South Atlantic States. Largest year-to-year increases were found among those who recently began feeding molasses. Variations in quantities used in Southwestern and West Coast areas occurred with changes in livestock numbers and reduction of forage crops by drought conditions.

Among users interviewed, there was a trend away from use of molasses as a free-choice feed to its use in combination with other feeds, particularly roughages, green chop, or silage. In the Northeast, there was also a tendency among users to discount use of molasses as a silage preservative, particularly for grass and legume silage stored in unwilted condition, because of leaching.

These latter changes in method of application tend to reduce the molasses fed per animal unit. Their effects have been more than offset by the increase in numbers feeding molasses. References to new users and to changes in method of feeding by users were much more frequent than reports of discontinuance of molasses use. For example, thirteen (11 percent) of the 117 users reported upon by this study had begun molasses feeding in 1954.

The percentage of beef cattle marketed from "factory type" feed lots is increasing. Use in feed lots is indicated to be one of the most successful applications of molasses. Several of the operators visited in the survey reported continuous use for more than 25 years.

A favorable factor in the competitive position of molasses in feed is its rather wide and increasing use with high roughage feeds for ruminants. Molasses used in this way serves an important function in aiding in the feed utilization of agricultural byproducts from oilseed, grain, and fiber crops.

Competition of Liquid Molasses and Dried Molasses Concentrate. --Less than half of all of the molasses users visited had tried a dried molasses concentrate. Only three were presently continuing its use, and they were using it only for silage making, to avoid handling liquid molasses in the ensilage blower system.

Few of the persons visited were feeding dried molasses products. Manufacturers of these products and feed mills and stores that handle them indicated that a large part of their volume went to farmers either for use in feed mixers or in making silage. Users of these products were not so easily located as were users of liquid molasses. Dried molasses products absorb a large proportion of the output of hydrol, citrus, and beet molasses, however, and also a considerable quantity of blackstrap.

Reactions of liquid molasses users who had used or had considered using dried molasses in the past are interesting from the standpoint of the competitive position of the two products.

Cost of the dry in relation to liquid molasses was the principal reason cited for not using dry molasses. Other reasons given were (1) caking in the opened bag, (2) lack of the characteristic molasses odor, and (3) lack of the moist feeling of liquid molasses in mixed feeds. In a few instances, the material used as a carrier was objectionable, on account of either the low nutritive value and high fiber content or the foreign matter found in the carrier.

Users of liquid molasses most frequently answered the question about using dried molasses by saying either that they would use it if it were as cheap as liquid molasses or that inasmuch as they were equipped for using liquid molasses they would be reluctant to change even if the prices were equal.

Several users of liquid molasses reported that, if they could not get liquid molasses, they would switch to sugar rather than to dried molasses. They said that on the basis of carbohydrates, sugar would be cheaper than dried molasses products at current delivered costs.

Distribution Factors Affecting the Position of Molasses in Livestock Feed. --Distance from the source of supply and volume of individual purchases are the two principal factors affecting the cost of molasses to users. In the section on costs of molasses to the user, it was indicated that costs of transportation from ports to interior market

points substantially reduced the price difference on an equivalent feed-value basis between molasses and corn. At the time this survey was made, molasses that sold in New Orleans at wholesale price of 10 cents a gallon cost 15 cents in Chicago, 20 1/2 cents in Minneapolis, 14 1/2 cents in St. Louis, and 17 3/4 cents in Kansas City. Farmers near these latter cities who buy molasses in tank truck lots could expect to pay these prices plus an additional transportation charge, depending upon the distance the trucker must haul it. At current molasses-corn price relationships, the economic advantages of molasses as a replacement for grains are considerably less than those achieved at points nearer to molasses sources or port terminals.

The unit of purchase of molasses is an important factor in the cost to the user. Lowest prices per gallon are for bulk lots of either a tank car or a tank truck delivery. The investment in storage equipment is the same whether one load or more is received during a feeding season. Purchasers of smaller volumes must choose either the higher cost less-than-tank-car or less-than-tank-truck lot or the investment in storage facilities which will allow receipt in bulk lots.

The small livestock feeder who requires less than a tank-truck load of molasses for an entire feeding season offers another problem to the distributor of molasses. At 5 pounds of molasses average daily consumption, a 3,000-gallon tank-truck load of molasses would last a herd of 70 cattle for 100 days. In order to reach the market of livestock feeders having less than this number of cattle with molasses at a price competitive with other feeds, tank truckers have established part-load deliveries in several areas, particularly where such users are concentrated. Although this price was slightly higher than the price for a full load, it was less per gallon than the cost reported by several who made drum-lot purchases.

In order to improve the marketing position of liquid molasses in north-central livestock feeding areas and other localities at a distance from bulk terminals, distribution costs must be lowered so that molasses can compete more favorably with other carbohydrates. Distribution methods now used to service the smaller dairies and livestock feeders must be modified and improved.

Expected Trends in Farm Use of Liquid Molasses. --At the time information was collected for this report, supplies of molasses were adequate and the price was low enough to permit feeding of liquid molasses in large quantities, particularly at points adjacent to terminals. However, with the higher value placed on molasses for use in mixed feeds and high roughage feeds, increasing use for these purposes would tend to push prices upward or curtail the supplies of liquid molasses available directly to farmers for feeding. This latter has already occurred to a large extent for citrus molasses, corn molasses, and beet molasses. Marketing of citrus molasses mixed with citrus pulp has reduced open-market supplies of liquid citrus molasses. Corn molasses is used for dried mixing concentrates with a high molasses content to an extent which takes most of the liquid molasses out of the open market. Selling beet molasses combined with beet pulp was found to be more profitable than selling molasses alone, and had taken about one-half of the available supply of this type.

Use of cane blackstrap molasses in feed obviously may follow a trend similar to those exhibited by other types of molasses. The result would be to limit the supply of molasses available to the farmer in liquid form and at an economical price. Obviously a feeder will try to use any particular feed in the way that will give maximum net returns. Trial and error and a competitive market must be depended upon to develop the most economical choices. Such choices will change, however, as improvements in practices occur at one or another point in the marketing process.

This survey developed relatively little reaction favorable to the use of dried molasses concentrates, but makers of these dried concentrates report an important and growing market for them. Also, the trend in use of molasses indicates that an increasing quantity of liquid molasses is going into ready-mixed feeds for all kinds of livestock.

Wherever the mixed feed use, whether ready-mixed or dried concentrate of molasses, becomes sufficiently advantageous to curtail the liquid molasses supply, livestock feeders will benefit to the extent of economies of molasses use in the mixed feeds. Insofar as liquid molasses continues to be available at more economical cost than other feeds of equal nutritive value, the problem of using liquid molasses on farms is an important, sometimes decisive, factor in profitable feeding.

APPENDIX

The users visited in this study were located by asking questions of tank-truck distributors, feed mill operators, feed store managers, feed brokers, and primary distributors of molasses who were interviewed on other phases of the study. In each case names, addresses, or other information leading to farm users of liquid or dried molasses were sought. In some areas, these inquiries resulted in information about more users than it was possible to visit; in other areas users of molasses on the farm were very scarce or little known.

On-the-farm users of molasses for silage preservation were not visited. This omission eliminated many of the users who were suggested by feed store and feed mill operators who handled molasses in drum lots.

Visits to farm users were made neither for the purpose of developing measurements of total use of molasses on farms nor to describe the average livestock feeder's use of molasses. Interviews were sought that would give the reader knowledge of the experiences of others in a feeding program, area, or type of use similar to his own.

The sample of feed mills in each of the four regions was obtained by sampling feed mills within selected States. These States typified for each region various conditions, such as distance from source, type of molasses source, availability of other carbohydrate feeding materials, nature of molasses distribution available, and types of livestock programs. Methods of using molasses, and the relationship of its use to that of other feeds on the farm, would also apply to these same selected conditions in the region.

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